indicates land well adapted to both dry and irrigation farming, the taller and thicker the sagebrush the richer the soil.

Areas next below the sagebrush are occupied by the *Kochia* (*K. vestita*) association, and this was found to indicate a soil of finer texture, with similar moisture conditions, but with only the first foot of soil free from an injurious quantity of alkali salts. Dry farming does not succeed on this area because of the small amount of soil free from alkali, while the relatively impervious nature of the soil prevents the washing out of the alkali by irrigation; hence *Kochia* land scarcely permits crop production.

Following the *Kochia* belt comes the shad scale (*Atriplex confertifolia*) association, with soil moisture and alkali conditions similar to the preceding, but with a soil containing much gravel. Here dry farming does not succeed, but with irrigation the alkali would be more readily washed out and hence the crop probabilities are better.

The study continues with the associations of the lower, more alkaline areas, indicating as before the agricultural possibilities of the land. In addition to the value of the various associations as crop indicators, their composition is detailed, the successions noted, and the root characters of the principal species studied. The report is an excellent example of applied ecology.—G. D. FULLER.

The ecology of Calluna.—The common European heather, *Calluna vulgaris*, has been regarded as a typical calciphobe by CONTEJEAN and other partisans of the chemical as opposed to the physical theory of plant distribution. Furthermore, the heather is regarded as partial to acid soils, which also are deficient in certain mineral constituents, and hence are betokened sterile. *Calluna* occurs in various places on the chalk downs of southern England, being accompanied by several other species that are alien to the ordinary flora of the chalk; usually the heather patches are sharply delimited from the surrounding chalk associations. Miss RAYNER[10] has been making some detailed investigations of *Calluna* on the downs, and although much remains to be explained, a large contribution has been made to the ecology of the species. On the downs the heather grows in neutral soil, rich in most ordinary mineral constituents, but poor in lime; the roots, however, often penetrate down into soil areas that are rich in lime. The proportion of magnesia is relatively high. Cultures were made in soil from the heather areas and in ordinary chalk soil containing over 40 per cent of calcium carbonate. In the latter soil there were noted certain abnormalities, such as reduced capacity for germination and arrested development of the various organs; extensive bacterial colonies developed about the roots, and the mycorhizal fungus developed poorly. The relation of *Calluna* to its root fungus is obligate; the primary root becomes infected

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[10] RAYNER, Miss M. C., The ecology of *Calluna vulgaris*. New Phytologist 12: 59–77. *pl. 1. figs. 2.* 1913; see also preliminary paper, *ibid.* 10:227–240. *figs. 2.* 1911.

shortly after germination, the mycelium coming from the seed coat which is infected while still in the ovary. In sterile cultures there is a complete arrest of root development. It is concluded that the so-called soil preference of *Calluna* depends upon the maintenance of a biological balance between the roots and the root fungi. The disturbance of this balance in soils rich in lime is responsible for poor growth in such soils. Probably also the increased bacterial growth in the chalk cultures is detrimental. It is to be hoped that the author will make a comparative study of *Calluna* in its ordinary habitat, where the soil is acid and infertile.—H. C. COWLES.

A new Tylodendron.—WEISS[11] has described a new form of *Tylodendron* under the name *T. Cowardi*. Particular interest in this specimen centers around the secretory canals and primary wood. WEISS says: "The outer portions of the pith have very numerous secretory canals with dark brown contents, very like those found in the Medullosae, in cycads, and also in the pith of *Poroxylon*. These have not been observed or described, so far as I know, in any other specimens of *Tylodendron* showing structure." There are also isolated groups of primary xylem at the periphery of the pith as in *Pitys antiqua*, but much smaller. Analogous structure is seen in *Mesopitys* of ZALESSKY and in *Cycadeoidea* of WIELAND. With regard to the systematic position of this *Tylodendron*, WEISS agrees with POTONIÉ that *Tylodendron* is of araucarian affinity. He considers that the pitting of the secondary wood, the double leaf traces, etc., are araucarian or cordaitean in character, and homologizes the secretory ducts in the pith with those in the same region of the cone of *Araucaria* and the stem of *Poroxylon*. WEISS further considers that since a *Tylodendron* has recently been described with discoid pith like the Cordaiteae, considerable light is thrown on the connection between the cordaitean and the araucarian forms, and that the study of this genus promises much along this line in the future.—R. B. THOMSON.

Plant invasion on Hawaiian lava flows.—Thanks to the initiative of TREUB, we are now well informed as to the revegetation of Krakatau. The successive lava flows from Mauna Loa, the age of many of which is exactly known, afford an excellent opportunity for comparable investigations. The results of a preliminary study of this sort are given by FORBES.[12] As is well known, the lava here is of two well defined sorts, the *pahoehoe*, which has a smooth and satiny exterior and may be ropy, and the *aa*, which has a cavernous and jagged exterior. On a lava flow of 1859, no vascular plants were found on the *aa*, though the surface was often white with lichens. To FORBES' surprise,

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[11] WEISS, F. E., A *Tylodendron*-like fossil. Mem. Proc. Manchester Phil. Soc. **57**: pp. 14. *pls.* 2. 1913.

[12] FORBES, C. N., Preliminary observations concerning the plant invasion on some of the lava flows of Mauna Loa, Hawaii. Occasional papers of the Bernice Pauahi Bishop Museum of Polynesian Ethnology and Natural History **5**:15–23. 1912.